

# Coal's Comeback

*Can coal become a clean energy source?*


Many Americans regard coal as a high-polluting fuel of the past, but today the U.S. is on the verge of a new coal energy boom. Coal-burning power plants generate half the nation's electricity, and that share could grow. More than 150 new coal power plants are planned or under construction, but critics oppose many of them. Coal is cheap and plentiful compared to other fuels, but it also produces air pollutants that contribute to acid rain, smog and climate change and cause thousands of deaths every year. Supporters say technology can make coal a pollution-free energy source in coming decades and that coal could even be used to make liquid fuels as a substitute for oil. But environmental and health advocates argue that the damaging impacts from mining, transporting and burning coal cancel out its value as an energy source. As Congress and the states debate proposals to combat global warming, regulators and businesses weigh coal's energy benefits against its health and environmental liabilities.



*A 100-car coal train travels through Wyoming in 2006. Coal generates half of the U.S. electrical supply, but environmentalists argue that burning coal contributes to acid rain and climate change. Supporters contend technology can eventually eliminate most pollution from coal.*

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# Coal's Comeback

BY JENNIFER WEEKS

## THE ISSUES

By any measure, Georgia Power's 2,500-acre Bowen generating facility is big. Two 1,000-foot smokestacks at the site northwest of Atlanta vent emissions from four coal-fired boilers high into the atmosphere. Bowen generated 22.6 million megawatt-hours of electricity in 2006, enough to power more than 2.3 million households.<sup>1</sup> When all of its units are firing, the plant burns three trainloads of coal daily — about 1,100 tons per hour.

Bowen has generated more electricity than any other fossil-fuel plant nationwide at least 10 times since it began operating in the early 1970s. "Bowen provides more than a quarter of the power we generate in the state of Georgia. It's very important to our company," says Lolita Jackson, a Georgia Power spokeswoman. "We're spending more than \$900 million to put in state-of-the-art environmental controls, and we're going to run it for a long time."

Bowen needs controls because it also produces huge amounts of air pollution. In 2006 it generated more carbon dioxide (CO<sub>2</sub>), the main greenhouse gas (GHG) that causes climate change, than all but two other coal-burning power plants nationwide. Bowen was the top emitter of sulfur dioxide (SO<sub>2</sub>), which causes acid rain and particulate pollution, and 14th for nitrogen oxides (NO<sub>x</sub>), which contribute to acid rain and smog. It is also a major source of mercury, a toxic heavy metal that causes neurological damage.<sup>2</sup> (See sidebar, p. 821.)

Americans depend on coal for more than half of their electricity, and that



AP Photo/The Daily Tribune News/Dayton P. Strickland

*Georgia Power's huge Bowen power plant in Euharlee burns 1,100 tons of coal per hour and is the third-largest emitter of carbon dioxide — the main greenhouse gas that causes global warming — among all coal plants nationwide. Energy firms like Georgia Power are investing heavily in environmental controls to offset pollutants from coal combustion, especially in the face of looming government regulation.*

share could grow. As of May 2007, 151 new coal-fired power plants were under construction or planned to meet steadily rising demand.<sup>3</sup> The Department of Energy projects that U.S. electricity sales will increase by 41 percent between 2005 and 2030, with coal's share growing from 50 percent of generation to 57 percent if current environmental policies remain unchanged.<sup>4</sup>

But coal's health and environmental impacts could darken that forecast. The deaths of nine miners in August at Utah's Crandall Canyon mine were a reminder that coal mining is one of the most dangerous occupations in the United States. From 1900 through 2006 more

than 104,000 coal mine workers died on the job.<sup>5</sup> Above-ground methods such as strip mining and mountaintop removal can wreak heavy environmental damage, although some mined lands have been reclaimed for other uses.

Burning coal has broader impacts. Studies have shown that air pollutants from coal-burning power plants and other large combustion sources cause thousands of deaths and illnesses every year.<sup>6</sup> They also contribute to acid rain, smog, and haze and contaminate oceans and streams with mercury.

Environmentalists want the United States to use more low-emission options like wind, solar power and biofuels.<sup>7</sup> "Coal power plants are the largest manmade source of CO<sub>2</sub> in our atmosphere," says Jennifer Coken, a campaign director for Western Resource Advocates (WRA), a Colorado-based environmental advocacy group. "Smokestack emissions reduce visibility at national parks. Water is a critical resource in the West, and coal plants divert huge amounts of water for cooling."

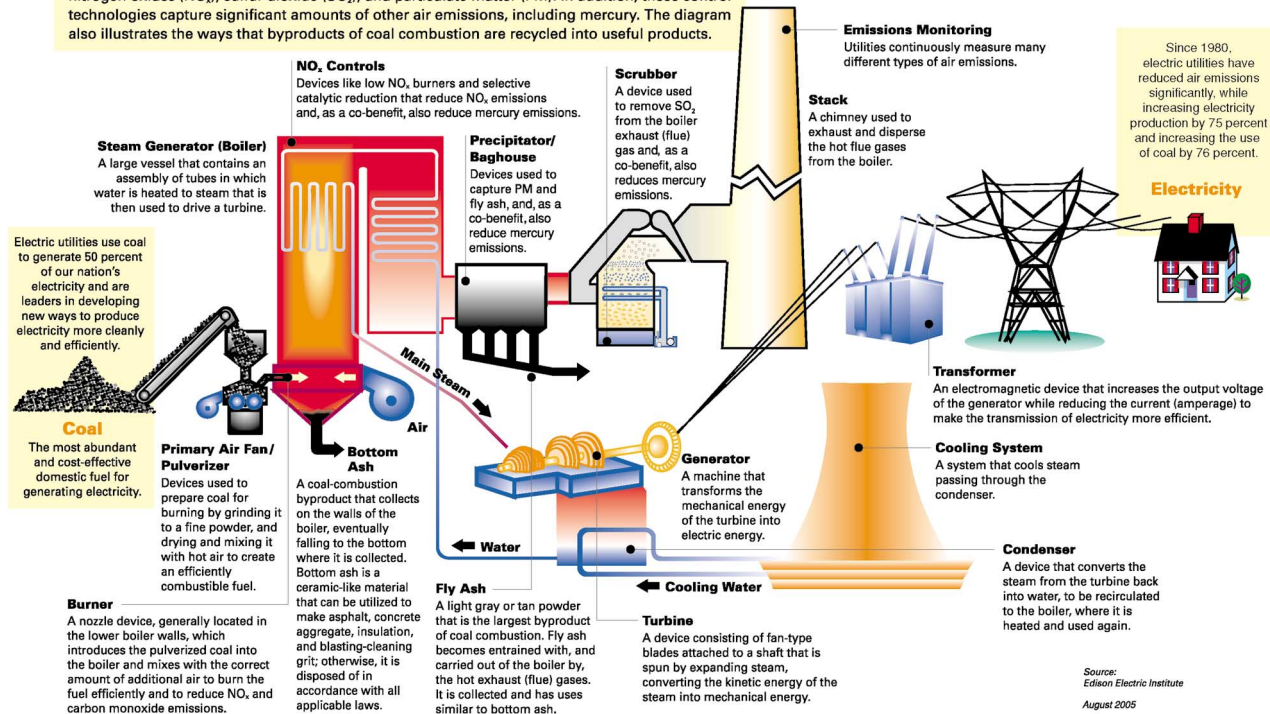
Other advocates see nuclear power as a clean alternative to coal, since nuclear reactors do not emit conventional air pollutants or CO<sub>2</sub> when they generate electricity. But critics say nuclear power is too dangerous and generates too much long-lived, difficult-to-dispose-of radioactive waste to be an acceptable energy mainstay.<sup>8</sup>

The Bush administration's national energy policy, issued in 2001, called for spending \$2 billion over 10 years to develop plants that burn coal more efficiently and produce less pollution. "We've got 250 years of coal, at least, in America. If we're interested in



## How Power Plants Are Reducing Air Emissions

This simplified diagram is illustrative of the operations at a large coal-based electric power plant. It explains the various control technologies in place at many U.S. power plants to reduce emissions to air, land, and water. These technologies are designed to control emissions of nitrogen oxides (NO<sub>x</sub>), sulfur dioxide (SO<sub>2</sub>), and particulate matter (PM). In addition, these control technologies capture significant amounts of other air emissions, including mercury. The diagram also illustrates the ways that byproducts of coal combustion are recycled into useful products.



becoming less dependent on foreign sources of energy, we ought to be using energy here at home in a wise way," President George W. Bush told a Cleveland audience on July 10. "But coal can be dirty and, therefore, we're spending a lot of your money on developing clean coal technologies."

According to a recent National Research Council study, Bush's 250-year supply estimate is impossible to confirm because it is based on 30-year-old data and methods. However, the United States probably does have enough coal to last for more than a century at current consumption rates.<sup>9</sup>

As of 2005, amendments to the Clean Air Act that were adopted in 1990 had cut SO<sub>2</sub> emissions by about 35 percent from 1990 levels and NO<sub>x</sub> emissions by 46 percent, at costs well below original government and industry projections. (See graph, p. 822.) "Air qual-

ity has continuously improved in the United States for particulate matter, ozone and acid rain," says John Kinsman, director of air quality programs for the Edison Electric Institute, which represents shareholder-owned electric power companies. "It will continue to improve in the future, and electric power SO<sub>2</sub> and NO<sub>x</sub> emission reductions are a major reason."

But in many parts of the nation SO<sub>2</sub> and NO<sub>x</sub> still contribute to high levels of secondary pollutants (contaminants that form through reactions in the atmosphere) such as ozone and fine particulates. "Air quality is much better than it was 20 years ago, but cleaner air is not clean air," says Janice Nolen, assistant vice president of the American Lung Association. "There is documented evidence of dreadful health effects from these pollutants at levels that all too frequently exist in the United States. Pol-

lution from coal power plants is still a problem."

Coal-fired electricity plants in the United States are a mix of old and new, including some that went into operation before World War II. Most plants have taken steps to reduce SO<sub>2</sub> and NO<sub>x</sub> emissions. Some, like Bowen, are adding controls now to meet the latest SO<sub>2</sub> and NO<sub>x</sub> targets, set by the Environmental Protection Agency (EPA) in 2005.

The EPA also issued a rule in 2005 designed to reduce mercury emissions from power plants for the first time, but critics argue that it is too slow and too weak. Meanwhile, CO<sub>2</sub> emissions from power plants are not controlled yet at the federal level. Bush contends that doing so would drive up energy prices, but some states are adopting their own greenhouse gas controls, and support is growing in Congress for national limits.

## Pollutants Caused by Coal Combustion

Pollutant	Effects	Control technologies
<b>Sulfur dioxide (SO<sub>2</sub>)</b> Formed when sulfur is exposed to oxygen at high temperatures.	<ul style="list-style-type: none"> <li>• Causes breathing difficulty and aggravates heart disease.</li> <li>• Dissolves in cloud droplets to form acid rain, which damages plants, acidifies lakes and kills aquatic organisms.</li> <li>• Reacts in atmosphere to form fine-particle pollution.</li> <li>• Sulfate particles create haze, reducing visibility.</li> </ul>	<ul style="list-style-type: none"> <li>• Flue gas-desulfurization units (scrubbers) remove SO<sub>2</sub> from gas exiting power plant boilers.</li> <li>• Switching to low-sulfur coal reduces production of SO<sub>2</sub> during combustion.</li> </ul>
<b>Nitrogen oxides (NO<sub>x</sub>)</b> Formed when fuel is burned at high temperatures.	<ul style="list-style-type: none"> <li>• Forms acid rain, fine particles and haze, with impacts similar to SO<sub>2</sub>.</li> <li>• Reacts with other pollutants to form ozone, a toxic air pollutant that causes lung damage, and smog.</li> </ul>	<ul style="list-style-type: none"> <li>• Low-NO<sub>x</sub> burners and other combustion technologies change the combustion process to reduce NO<sub>x</sub> formation.</li> <li>• Post-combustion processes inject chemicals into flue gas to remove NO<sub>x</sub> before it is emitted.</li> </ul>
<b>Fine particles</b> Formed when SO <sub>2</sub> and NO <sub>x</sub> react with other chemicals in the atmosphere.	<ul style="list-style-type: none"> <li>• Aggravate respiratory problems like asthma and bronchitis, and heart ailments such as irregular heartbeats. Exposure causes premature deaths in people with heart and lung diseases.</li> <li>• Particles create haze, reducing visibility.</li> </ul>	<ul style="list-style-type: none"> <li>• Electrostatic precipitators and filters remove particles from flue gas.</li> </ul>
<b>Mercury</b> Released when coal is burned.	<ul style="list-style-type: none"> <li>• Accumulates in the environment and is passed up the food chain.</li> <li>• Causes growth and reproductive problems in fish, animals and birds, and neurological damage and birth defects in humans.</li> </ul>	<ul style="list-style-type: none"> <li>• SO<sub>2</sub> and NO<sub>x</sub> controls reduce some mercury emissions.</li> <li>• Municipal waste and medical waste incinerators inject activated carbon into flue gas to remove more mercury; this process is being studied for use at power plants.</li> </ul>
<b>Carbon dioxide (CO<sub>2</sub>)</b> Produced when any fuel containing carbon is burned.	<ul style="list-style-type: none"> <li>• Promotes global climate change by trapping heat in the atmosphere.</li> </ul>	<ul style="list-style-type: none"> <li>• CO<sub>2</sub> can be chemically separated from flue gas after combustion in a conventional coal plant or from gasified coal before combustion in an IGCC (integrated gasification combined cycle) plant.</li> </ul>

New clean-air standards, such as limits on CO<sub>2</sub> emissions, could force power plant owners to spend hundreds of millions of dollars to install additional control systems. Electric utilities would have to raise prices, reducing coal's competitive advantage over cleaner but more expensive fuels like natural gas, nuclear power and renewable sources like solar and wind. New environmental controls thus could pre-

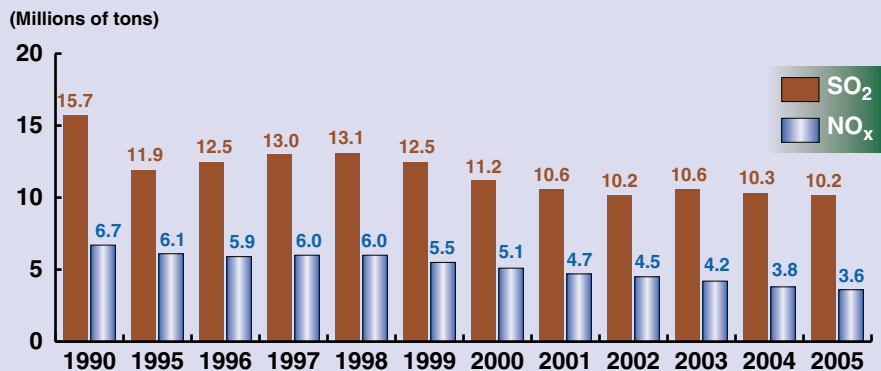
vent currently planned coal plants from being built, as many environmentalists hope.

Some companies already have backed away from planned new plants. In April 2006 the TXU Corp. announced plans to build 11 new coal-fired generating units in Texas, an expansion equivalent to more than 3.5 percent of the entire U.S. coal-burning fleet. The company asserted the plants would

make the air cleaner because they would replace older, dirtier units without modern pollution controls. Critics replied that building coal plants instead of cleaner power sources would be disastrous for public health and the environment. They also accused TXU of pushing for quick permits so that it could build the plants before any future limits on greenhouse gas emissions took effect.<sup>10</sup>

## Acid Rain Emissions Are Declining

*Emissions of sulfur dioxide dropped by 35 percent from 1990 through 2005, and NO<sub>x</sub> emissions fell by 46 percent, despite a 24 percent increase in power generation.*



Source: "Acid Rain Program, 2005 Progress Report," EPA

"Here we are in the 21st century, and the governor and TXU are trying to meet our state's energy needs with a 19th-century fuel source," said Neil Carman, clean air program director of the Sierra Club's Lone Star chapter.<sup>11</sup>

With more than 30 Texas cities and towns opposing the new plants and TXU's stock price dropping, shareholders grew nervous. In February 2007 the corporation's board voted to accept a \$45 billion leveraged-buyout offer from two private equity firms. As part of the deal investors agreed to cancel eight of the new coal plants, support mandatory national controls on carbon emissions and invest \$400 million in energy efficiency and conservation measures, plus other environmental commitments.<sup>12</sup>

"All of the issues at play in Texas are applicable to other companies," says Dan Bakal, electric power program director at Ceres, a network of investor, environmental and public interest groups that promotes corporate social responsibility.<sup>13</sup> "As electricity providers plan future investments they need to analyze business risks associated with climate change, explore technologies for managing carbon emissions and plan

for cost increases, including policies that put a price on carbon."

As lawmakers, state officials and energy companies try to balance coal's energy value against its negative effects on health and the environment, here are some of the issues they are debating:

### ***Should new coal plants be required to capture carbon emissions?***

As evidence mounts that greenhouse gas (GHG) emissions are causing significant climate change, Congress is debating proposals for mandatory national GHG limits.<sup>14</sup> Coal-burning power plants emit more CO<sub>2</sub> per unit of electricity produced than any other fuel. But an evolving technology called carbon capture and storage (CCS) holds the promise of making coal-based electricity nearly carbon-free.<sup>15</sup>

CCS systems chemically separate CO<sub>2</sub> from power plant flue gas and compress it into a fluid for underground injection. A 2007 study by a panel of scientists and engineers at MIT called CCS "the critical enabling technology that would reduce CO<sub>2</sub> emissions significantly while also allowing coal to meet the world's pressing energy needs." The authors rec-

ommended more than doubling current U.S. spending to address the two-part challenge of demonstrating advanced coal-generation technologies using carbon capture and finding potential underground storage sites.<sup>16</sup>

Adding CCS to power plants is technically challenging and raises plant costs. The chemical conversion processes involved in capturing carbon emissions use some of the steam output that normally would turn turbines to generate electricity, so the plant makes less electric power from a given amount of coal. Plants with CCS thus need bigger boilers and steam turbines to produce as much power as conventional plants. Companies designing plants with CCS need roughly 20 percent more space for these larger components and for equipment to capture, recover and compress CO<sub>2</sub>.

The MIT study concluded that plant owners were unlikely to retrofit existing coal-fired plants with CCS given the costs and technical challenges. However, it said CCS could work with many types of new coal plants, including high-efficiency versions of today's pulverized-coal plants (so called because they burn coal that has been ground to a fine powder).

Environmentalists favor a newer integrated gasification combined cycle (IGCC) plant, which converts coal to gas, cleans most pollutants from the gas before combustion and then burns the gas. Only two IGCC power plants (without CCS) are operating today in the United States, but about one-fifth of the coal plants on the drawing boards are IGCC plants. IGCC generates electricity at a higher cost today than pulverized-coal plants but uses less water and produces fewer air pollutants.

Carbon storage is also an evolving field. Energy companies routinely inject CO<sub>2</sub> and other gases underground to increase pressure and maximize yields from oil and gas deposits, but only three projects worldwide, in Norway, Canada and Algeria, are injecting up to

1 million metric tons per year. Offsetting a significant fraction of human-generated CO<sub>2</sub> emissions could require capturing and storing a billion tons or more yearly. The MIT study called for about a dozen major demonstrations in different geological settings around the world, plus government support for three to five commercial-sized coal-burning plants with carbon capture.

"We need large-scale demonstration projects, which will take 8 to 10 years," says MIT chemical engineering professor and study coauthor Howard Herzog. "At that point CCS should be ready to go mainstream if the government has provided economic incentives for capturing and storing carbon, either by putting a price on carbon emissions or limiting power plant emission rates."

Many observers expect that within the next several years Congress will set national limits on CO<sub>2</sub> emissions. Lawmakers will either tax them at a certain fee per ton or cap total emissions and require power plants to buy allowances to cover any CO<sub>2</sub> they release above their individual quotas (a so-called cap-and-trade system because plants with extra allowances can sell them to others that need them). The MIT study estimated that pricing CO<sub>2</sub> emissions at \$30 per ton through one of these methods would make it economically competitive to build new coal plants with CCS instead of today's designs. Owners would pay more for CCS technology up front but would not have to pay taxes on emissions or buy allowances to cover them.

But if the government sets a lower price on CO<sub>2</sub>, fewer energy companies are likely to invest in power plants with expensive CCS technology. "We need a serious carbon policy for coal plants with CCS to be built on a large scale. A small carbon tax won't lead to many new plants being built quickly," says Herzog.

Some environmental advocates say that no more coal plants should be built until CCS is ready. "There should

be a moratorium on building any more coal-fired power plants until we have the technology to capture and sequester the CO<sub>2</sub>," prominent climate scientist James Hansen, director of NASA's Goddard Institute for Space Studies, told a National Press Club audience in February. "It will become clear over the next 10 years that coal-fired power plants that do not capture and sequester CO<sub>2</sub> are going to have to be bulldozed."<sup>17</sup>

Some politicians agree with Hansen. Sen. Christopher J. Dodd, D-Conn., and former Sen. John Edwards, D-N.C., both seeking the Democratic presidential nomination in 2008, say they would ban new coal plants without CCS.<sup>18</sup> Others support emission performance targets that coal plants could only meet by capturing CO<sub>2</sub>. Earlier this year California barred electric utilities from signing new contracts with sources that produce more than 1,000 pounds of CO<sub>2</sub> per megawatt-hour, including out-of-state plants.<sup>19</sup> Sen. John Kerry, D-Mass., has introduced legislation requiring all new coal-fired plants to emit no more than 285 pounds of CO<sub>2</sub> per megawatt-hour.<sup>20</sup>

Energy companies say that moratorium proposals are unrealistic with electricity demand rising. "[G]iven the growth of power demand in the U.S., we're getting to the point where many regions of the country are starting to look at shortages over the next couple of years, and we're going to have to start building some baseload coal plants, using the best available technologies," DTE Energy Chair Anthony Earley said in July.<sup>21</sup> \*

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\* Baseload plants run almost constantly except when they are shut down for maintenance, and are used by power companies to meet the bulk of customer demand. Smaller "peaking" plants are brought into service at times when demand is highest, such as the hottest days of summer. Coal plants are best suited to provide baseload power because they are slow to fire up and cool down.

According to the MIT study, adding CCS to IGCC plants is cheaper than adding it to pulverized coal plants with current technology. But the authors concluded that it was too early to anoint one preferred CCS option because research to improve coal generation is under way around the world. They were also skeptical of a concept, advocated by some officials and environmentalists, that future plants should be made "capture ready" through steps such as designing them with extra space for CCS equipment.

"CCS isn't like a cable-ready TV that you can plug right in," says MIT's Herzog. "There's not a lot you can do up front to make that switch-over to carbon capture at an operating plant any easier. We're better off spending money to build plants with capture systems today, and those will need government support. That's where large-scale demonstrations come in, to set the stage."

Others want to move faster. The Natural Resources Defense Council (NRDC), an environmental advocacy group, argues that technologies for CCS at IGCC plants are available today. In NRDC's view, the most urgent need is for policies that will make coal plant owners start using these systems — for example, a national emission-performance standard like California's that limits how much CO<sub>2</sub> plants can release per unit of electricity generation.

"Decisions being made today in corporate board rooms, government ministries and congressional hearing rooms are determining how the next coal-fired power plants will be designed and operated," NRDC analysts David Hawkins and George Peridas wrote earlier this year. "If all 3,000 of the next wave of coal plants [forecast worldwide] are built with no CO<sub>2</sub> controls, their lifetime emissions will impose an enormous pollution lien on our children and grandchildren."<sup>22</sup>

## Burning Coal Produces Most Pollutants

*Burning coal at U.S. power plants creates, on average, more pollutants per megawatt-hour (MWh) of electric-power generation than any other fuel.*

### Pollutants From Fossil Fuel-Burning Power Plants

	Natural Gas	Oil	Coal
Sulfur dioxide (SO <sub>2</sub> )	0.1 lbs/MWh	12 lbs/MWh	13 lbs/MWh
Nitrogen oxides (NO <sub>x</sub> )	1.7 lbs/MWh	4 lbs/MWh	6 lbs/MWh
Carbon dioxide (CO <sub>2</sub> )	1,135 lbs/MWh	1,672 lbs/MWh	2,249 lbs/MWh

Source: EPA

### Is mercury emissions trading safe?

Mercury is a natural element found in trace amounts in rocks and ores, including coal. But a little bit goes a long way: According to the EPA, the maximum daily amount of mercury that a 140-pound adult can be exposed to without health effects is 6.3 millionths of one gram.<sup>23</sup> In larger doses mercury interferes with the brain and central nervous system. The expression “mad as a hatter” is based on the experiences of 19th-century English hatmakers, who developed muscle tremors, distorted speech and hallucinations after they used mercury solutions to cure furs.

Mercury enters the environment from natural sources, like volcanic eruptions, and human activities such as burning coal. It travels through the atmosphere, then falls to Earth, where bacteria in soils and wetlands convert it to a toxic form called methylmercury that accumulates in living tissues. As of 2006, 48 states had issued warnings against eating certain species of fish caught in local rivers, lakes or coastal waters because of mercury contamination.<sup>24</sup>

Coal-fired power plants produced nearly 48 tons of mercury in 1999, about 42 percent of U.S. mercury emissions. The Bush administration, energy companies and health and environmental groups agree that mercury emissions from coal plants should be reduced but disagree sharply on how to do it.

The Clean Air Act classifies mercury as a hazardous air pollutant. More than a decade ago, the EPA agreed in a legal settlement to set mercury emissions standards for power plants by 2004, using “Maximum Available Control Technology” as required by the act. The agency convened a working group in 2001 to help develop standards, but halted work in 2003. “There was total silence for nine months, and then EPA took a very different approach,” says panel member Praveen Amar, science and policy director at Northeast States for Coordinated Air Use Management (NESCAUM), a Boston nonprofit that analyzes air-quality issues for state governments.

EPA’s Clean Air Mercury Rule (CAMR), which became final in 2005, uses allowance trading to reduce mercury emissions. Like the SO<sub>2</sub> trading program that Congress created in 1990, CAMR caps total allowable mercury releases and gives each state an emissions “budget” to allocate among power plants. Plants that reduce emissions below their allotted levels can sell extra allowances to higher emitters. EPA estimates that the rule will reduce mercury emissions from coal plants by 70 percent from current levels, to 15 tons per year when fully implemented in 2025.<sup>25</sup>

Energy companies support trading because, instead of making them install specific control technologies at every plant, it lets them choose whether to

reduce emissions or buy allowances, and if they reduce, how to do it. “A national cap-and-trade program is the most cost-effective means to achieve substantial mercury emission reductions,” says Michael Rossler, manager of environmental programs at the Edison Electric Institute. “It’s also an efficient and flexible approach for states, which ultimately translates into a low-cost option for electric consumers.”

Critics say that the rule will take too long to reduce mercury emissions and could create dangerous mercury concentrations near sources that buy allowances instead of cutting emissions. The rule “leaves hundreds of plants using antiquated control technology for two or more decades and significantly increases the risk of toxic hotspots downwind of such plants,” Sens. Patrick J. Leahy, D-Vt., and Olympia J. Snowe, R-Maine, wrote to colleagues in August 2005. Forty-seven senators voted for a resolution offered by Leahy and Snowe opposing the rule.<sup>26</sup>

EPA officials say agency modeling shows that mercury emissions trading will not produce hotspots. “We found that on average, CAMR would reduce power plant mercury emissions by about 70 percent across the United States when it’s fully implemented,” says Robert Wayland, director of the energy strategies group at EPA’s Office of Air Quality Planning and Standards. “Some studies have shown higher-than-average mercury deposition in selected spots, but we concluded that overall reductions on this scale would prevent hotspots from occurring.”

But recent studies in the Northeast paint a different picture. A report published in 2007 by scientists affiliated with the Hubbard Brook Research Foundation in New Hampshire identified five actual and nine potential biological mercury hotspots in the Northeast (areas where mercury levels in many samples of key fish, birds or mammals, such as yellow perch and common loons, exceed human



and ecological health thresholds).<sup>27</sup> A companion study reported high mercury concentrations in fish and fish-eating wildlife across the region. The authors estimated that cuts required under the mercury rule would probably not be deep enough to protect human and environmental health.<sup>28</sup>

The EPA asserts that much of the mercury contaminating U.S. waters comes from non-U.S. sources, but these analyses concluded that nearby coal-fired power plants produced about 40 percent of regional mercury deposition. The authors suggested that EPA's computer models might be underestimating mercury pollution from nearby sources, and that mercury emissions trading might perpetuate or worsen hotspots.<sup>29</sup>

"I don't think atmospheric modeling of mercury is a very mature science. We're learning more all the time, but it's an area that's growing rapidly," says Syracuse University environmental engineering Professor Charles Driscoll, a coauthor of the Hubbard Brook studies. "There are problems with a lot of the information in national emission inventories, and many numbers for various forms of mercury are estimated rather than measured."

The EPA has discussed modeling methods with the Hubbard Brook scientists, says Driscoll, but the agency needs to work with states and regions to monitor mercury deposition and environmental concentrations. "That's what has made the SO<sub>2</sub> trading system work — they have detailed measurements of ecosystem levels and air-quality measurements, so they can track effects. But there's much less data on mercury," says Driscoll. "If that kind of program was in effect, you would know how a trading program was working and whether it was reducing mercury levels in the environment."

EPA does not contest the Hubbard Brook findings, although the agency says its models do a better job of predicting complex chemical reactions that mercury undergoes in the atmosphere.

"They did their analysis in a different way, but studies like [the Hubbard Brook reports] will continue to influence the science and provide information that we need to develop a comprehensive mercury-monitoring network," says EPA's Wayland.

Sixteen states have filed a lawsuit challenging the mercury rule. Many of these states, along with others not involved in the lawsuit, have adopted or are developing more stringent technology-based mercury limits than the EPA rule.

EPA and energy companies also say that activated-carbon injection, the most advanced technology for removing mercury emissions from plant flue gas, needs more study to make it work on large plants that burn various types of coal. But some experts, including NESCAUM's Amar, disagree.

"The technology is here. It's widely used on municipal waste incinerators, which used to be big mercury sources," says Amar. "Many states have decided that technology controls are more straightforward than trading and are cost-effective. Mercury controls are not just about averages, and small cost savings to industry from trading may not be worth introducing more uncertainty about hotspots."

### ***Should mountaintop removal mining be banned?***

As Congress and regulators work to reduce air pollution from coal combustion, fuel providers are looking for low-sulfur coal to mine. One source is the central Appalachian basin, which reaches from southern West Virginia into southwestern Virginia, eastern Kentucky and small areas in Tennessee. But grassroots organizations argue that mining these coal seams is destroying ecologically valuable lands and traumatizing local communities.

Surface miners use a range of methods to remove overlying rock and soil, known as overburden, and expose coal seams. In Western states where coal seams lie just a few feet below the prairie, over-

burden can be plowed away with gigantic bulldozers and earth-movers. But Appalachia's high, narrow hills and deep valleys require a different approach.

Mountaintop removal, a technique that has come into increasing use over the past 30 years, clears away topsoil and vegetation, then uses millions of pounds of explosives to blast away rock, sometimes reducing site elevation by hundreds of feet. Since slopes are too steep to pile overburden beside the mine, the material is dumped into adjoining valleys.

"Coal in these areas is found in very narrow seams, and the surrounding rock geology is less stable than in areas with larger seams, so the only safe way to mine it is to go straight at it from the top," says National Mining Association Senior Vice President Carol Raulston. "It creates flat terrain on what was the top of the mountain, but the mountain is still there."

A 2005 EPA review estimated that mountaintop mining and valley fills (MTM/VF) would affect more than 800,000 acres (1,250 square miles) of Appalachian forests between 1992 and 2012. Some 1,200 miles of headwater streams — the small creeks and streams that feed most major rivers — were buried by MTM/VF between 1992 and 2002.<sup>30</sup>

Southern Appalachia has unusually diverse plant and animal populations, and many scientists believe that MTM/VF threatens this ecologically rich area. EPA's environmental review called Appalachia's ecoregions "unique in the world," with many native plants, animals and fish, as well as rich forests that "have been profoundly altered over the past few centuries and are becoming increasingly threatened."<sup>31</sup>

Local groups say mountaintop mining is stressful and dangerous for people living nearby. The process worsens local flooding, says Judy Bonds, outreach director for Coal River Mountain Watch (CRMW), a West Virginia citizens' group. "When mountains are denuded

## COAL'S COMEBACK

and local streams fill up with sediment, there's more runoff from steep slopes that causes flooding for miles downstream," says Bonds. "I know people who sleep in their street clothes at night because they've been through flooding and worry about having to run again in the middle of the night."

Mountaintop mining also "breaks windows and cracks house foundations," she says. "You can smell and taste the explosive dust in your mouth afterward. It's all over your property and in your lungs. Mine runoff and selenium discharges contaminate our fishing streams and drinking water, so people have to go out and pay for public water access instead. \* We can't even swim in our own streams any more." <sup>32</sup>

Regulators at the federal Office of Surface Mining, Reclamation and Enforcement (OSM) and state agencies say surface mining is much more stringently regulated today than it was before Congress passed the Surface Mining Control and Reclamation Act (SMCRA) in 1977 to curb abuses in strip mining, in which operators scrape away soil and rock to expose large coal seams lying near the surface. "Although there are still impacts from mining, the practice is now carefully planned and permitted with extensive scientific, regulatory and public input," West Virginia Secretary of Environmental Protection Stephanie Timmermeyer told the House Natural Re-

sources Committee in July. <sup>33</sup>

Community groups disagree. "OSM has used, and has allowed the states to use, [SMCRA] as a perverse tool to justify the very harm that Congress sought to prevent," Joe Lovett, director of the Appalachian Center for the Economy



*Flat land is all that remains after miners blasted away the top of a mountain in the Appalachians. As regulators seek to reduce pollution from coal combustion, energy providers are increasingly turning to mountaintop-removal mining for low-sulfur coal.*

and the Environment, told the same hearing. "The members of Congress who voted to pass the Act in 1977 could not have imagined the cumulative destruction that would be visited on our region by the complete failure of the regulators to enforce the act." <sup>34</sup>

Mountaintop removal critics have won a series of favorable rulings from the U.S. District Court for the Southern District of West Virginia, although some have been reversed on appeal. Most recently, Judge Robert Chambers ruled in March that the U.S. Army Corps of Engineers failed to comply with the National Environmental Policy Act and the Clean Water Act in issuing four mountaintop removal permits without fully considering the ecological importance of streams that would be buried. <sup>35</sup>

In June, Chambers ruled against another mountaintop removal practice:

damming streams below valley fills to create sediment-control ponds, where solids washing down from the mine waste settle out before the stream flows on downhill. The Corps of Engineers classifies these ponds as waste-treatment systems and exempts them from Clean Water Act water-quality standards. But Chambers held that the act applied starting at the lower edge of valley fills, so the Corps could not let mining companies turn streams into waste-filtering systems. <sup>36</sup>

"The decisions prove our point that these steep slopes and narrow valleys are valuable," says Bonds. "You can't strip mine coal in Appalachia without destroying the water supply because of our topography. People think this is a throwaway region, but these streams are the sources of important water supplies for East Coast cities."

Coal industry representatives argue that they need settling ponds to treat pollution and meet Clean Water Act requirements. "This judge's decision says the Clean Water Act is illegal. It says SMCRA is illegal. It's surreal," said West Virginia Coal Association Vice President Jason Bostic. <sup>37</sup> Coal companies are appealing the ruling, with support from the National Mining Association. "There's a history of troubling decisions from this court that have ultimately been reversed on appeal," says Raulston.

According to the association, mountaintop removal accounted for about 16 percent of national coal production and one-third of annual production from Appalachia in the past several years. Not all of the coal seams could be accessed by other means. "Just because you can doesn't mean you should.

*Continued on p. 828*

\* Selenium, a naturally occurring mineral that is toxic in moderate doses, has leached from mountaintop removal sites and contaminated a number of West Virginia rivers and streams.

# Chronology

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## 1920s-1960

***Mechanization makes coal mines bigger and more efficient. Miners win basic workplace safeguards.***

### 1920s

Mechanical loading equipment replaces hand loading.

### 1930

Molded protective helmets for miners are introduced.

### 1937

Coal shuttle car is invented; electric hauling equipment for coal and refuse starts replacing mules at mines.

### 1943

President Franklin D. Roosevelt nationalizes U.S. coal mines to maintain production during a wartime strike.

### 1945-1960

Coal use for heating and powering trains and ships declines. Oil replaces coal as largest primary U.S. energy source.

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## 1960s-1990s

***Rising demand for electricity spurs surge in coal production. Concerns about environmental impacts of mining and burning coal spur new regulations.***

### 1970

Clean Air Act sets national air-quality standards for pollutants including sulfur dioxide, nitrogen oxides and fine particulates.

### 1972

Congress adopts Clean Water Act, which bars dumping wastes into U.S. waters without a permit. . . .

Flooding kills 125 people and leaves 4,000 homeless after a coal slurry impoundment dam bursts in Logan County, W. Va., on Feb. 4, releasing 132 million gallons of mine wastewater.

### 1973-74

Arab oil embargo increases demand for coal, raising prices. . . . Surface mining, especially in Western states, generates growing share of U.S. coal output.

### 1977

Surface Mining Control and Reclamation Act (SMCRA) regulates strip mines and requires operators to restore sites after mining. . . . Congress adds New Source Review (NSR) program to Clean Air Act, grandfathering existing plants unless they expand their capacity.

### 1979

Accident at Three Mile Island nuclear plant near Harrisburg, Pa., stalls expansion of nuclear power.

### 1992

Congress amends Clean Air Act, creating a cap-and-trade system to reduce emissions that contribute to acid rain.

### 1993

Price ceilings on natural gas are eliminated, increasing production but letting prices rise and fall with supply and demand.

### 1997

United States signs Kyoto Protocol on greenhouse gas emissions, but Senate opposition deters Clinton administration from submitting it for ratification.

### 1999

Justice Department files 51 lawsuits against electric power producers in 10 states for NSR violations.

## 2000s

***Rising energy prices and supply crises spur new demand for coal. The Bush administration supports increased production, but critics say the U.S. needs to use less coal, not more.***

### 2000

Oil and gas prices rise as domestic output falls, energy demand increases in developing countries and production drops because of conflicts in major exporting countries.

### 2001

President George W. Bush reverses a campaign pledge to regulate CO<sub>2</sub> emissions. . . . Administration's energy plan calls for funding clean-coal technology research, offering new emission-trading legislation and reviewing the NSR program and pending enforcement cases to see whether they are preventing companies from building or expanding power plants.

### 2002

EPA releases new rules allowing companies to modify plants without seeking NSR permits as long as emissions will not exceed caps on specific pollutants.

### 2005

Energy Policy Act of 2005 provides \$1.8 billion for research on clean-coal technologies and \$3 billion to promote pollution-control upgrades at existing plants and construction of new, advanced coal plants.

### 2007

TXU Energy Corp. cancels eight of 11 planned coal plants and accepts a leveraged-buyout offer after controversy over the plants drives the company's stock price down. . . . Nine miners die at Crandall Canyon mine in Huntington, Utah.

# Beyond Picks and Shovels

*Today's miners use computers and GPS.*

Humans have been extracting coal from the Earth since the Middle Ages. For centuries, miners hacked coal from underground deposits with picks and hammers and hauled it out in carts, often using children to pull loads through narrow tunnels.<sup>1</sup> Today, however, coal mining in the United States and other industrialized nations has entered the computer age.

"There's a misunderstanding that coal mining is an antiquated business that relies on manual labor," says Mike Mosser, manager of the Mining Industries of the Future program at the Energy Department's National Energy Technology Laboratory. "Mining coal in 2007 is a technologically sophisticated, highly engineered discipline for extracting energy. It's capital-intensive, and it generates a lot of jobs."

Cutting, cleaning and transporting coal are all highly mechanized processes today. Operators use wireless communications, sensors and computerized controls to guide machinery. The traditional approach to underground mining is called the "room and pillar" method: Miners remove coal in sections, leaving large pillars of coal intact to support the rock and soil above. In the 1950s and '60s, hand-drilling and blasting was replaced by "continuous mining" machines, which carve coal from the rock face with spinning toothed cylinders and feed it onto conveyor belts for transport to the surface.

A newer technique, longwall mining, instituted in the 1980s, uses specialized machines to cut swaths from blocks of coal up to 15,000 feet long, working back and forth across the coal face under movable roof supports. "It's just like mowing grass," says Mosser. "Longwall mining has kept U.S. coal companies competitive in world markets." As of 2003, more than half of U.S. underground coal production came from longwall mining.<sup>2</sup>

Surface-mining methods also have changed radically with mechanization. In the 19th century, surface miners hitched horses to plows and steel scrapers to uncover coal seams near the surface. Now huge trucks, bulldozers and excavators move vast quantities of material. The "buckets," or scoops, on large dragline excavators can be large enough to hold several auto-

mobiles. Some operators use global positioning systems (GPS) to guide machinery as it exposes coal seams.

Technical advances have also made mining safer. For centuries miners stabilized tunnel roofs with timber supports, which often collapsed, especially when each miner was responsible for securing his own work area in the years before regulation. Roof bolting, introduced in the 1950s and required by law in 1969, replaced timbers with high-strength bolts drilled upward to tie overlying rock layers together. Newer mining machines with sensors and video monitors can be controlled remotely hundreds of feet away from the rock face. And researchers are working to design robots that can map mines and detect dangerous gases.<sup>3</sup>

But some technical advances create new safety issues. For example, moving-vehicle accidents are a leading cause of deaths and injuries at coal mines. Some 300 workers are injured every year by falling as they climb in and out of gigantic mining trucks, and drivers often collide with people or smaller vehicles nearby or accidentally back their enormous vehicles off the road. Federal regulators are studying ways to reduce these accidents by equipping mining vehicles with sensors and cameras.<sup>4</sup>

Accidents such as the collapses at West Virginia's Sago mine in 2006 and the Crandall Canyon mine in Utah this year have also highlighted the need for better communications technology underground. "When you have an accident or flood, if you're communicating by wire you lose contact with your people," says Mosser. "Wireless communications are a research priority for underground mining. It's better than it was 50 years ago, but we need to get it to a higher level."

<sup>1</sup> Barbara Freese, *Coal: A Human History* (2003), pp. 46-47, 77-78.

<sup>2</sup> U.S. Energy Information Administration, "Coal Production in the United States: An Historical Overview," October 2006, p. 5.

<sup>3</sup> Eric Weiner, "Could Robots Replace Humans in Mines?" National Public Radio, Aug. 7, 2007.

<sup>4</sup> National Institute for Occupational Safety and Health, "Safety Enhancements for Off-Road Haulage Trucks." <http://0-www.cdc.gov/niosh/nas/mining/researchproject62.htm>.

*Continued from p. 826*

We have a lot of asbestos left, but we don't mine that any more," says Bonds, who hopes to end mountaintop mining within the next five years.

But it won't be easy to replace sources that are providing about one-sixth of the nation's coal supply, Bonds acknowledges, especially if electricity demand keeps rising. "It's going to take public outcry, litigation and a national energy shift," she says. ■

## BACKGROUND

### Powering America

Americans have put coal to many uses since colonial times, from heating homes to operating steam engines and manufacturing glass, iron

and steel. In 1882 inventor Thomas Edison opened a new chapter when he started operations at Pearl Street Station in lower Manhattan, the nation's first commercial electric generating station (powered by coal-fired boilers). As this new form of energy gained acceptance, coal surpassed wood as the dominant U.S. energy source for the next 70 years.

Coal was less bulky than wood, had a higher energy content and created



steady, long-lasting fires. By the turn of the 20th century, millions of Americans depended on coal for heat and cooking and to run factories. Leading industrialists like Andrew Carnegie and Henry Clay Frick amassed fortunes by linking railroad and steel companies into huge conglomerates powered by coal.

Rising demand for coal intensified struggles within the industry over low wages and dangerous conditions. Many coal companies violently suppressed miners' efforts to form unions. In a notorious 1914 instance, National Guard troops machine-gunned and burned a camp of striking miners at Ludlow, Colo., killing 21 people, including 11 children. The Ludlow Massacre capped a 14-month strike in which some 66 miners died. It focused scathing criticism on magnate John D. Rockefeller, owner of the largest coal company in Colorado, and helped draw public attention to the hardships of coal mining.<sup>38</sup>

Conditions for miners finally started to improve in the 1930s with New Deal reforms. The 1933 National Industrial Recovery Act and the 1935 National Labor Relations Act guaranteed most private-sector workers the right to unionize, while the 1938 Fair Labor Standards Act established a minimum wage, maximum work week and standards for overtime and restricted the use of child labor. Previously, youths had long been employed in mines or as "breaker boys," who bent over chutes for 10 or more

hours a day sorting waste and rock from fast-moving streams of coal.

Coal helped power Allied forces to victory in World War II, but after the war oil became America's fuel of choice. New oilfields in the Middle East and Latin America pumped out such abundant supplies that oil became cheaper than coal. Liquid fuels were easier to handle and transport, and oil burned more cleanly than coal, although it still produced significant pollution.

Repeated strikes in the U.S. coal industry also drove manufacturers to seek more reliable substitutes. During a strike in 1943, President Franklin D. Roosevelt placed U.S. coal mines under federal control and used a "fireside chat" radio address to urge



*Coal miner Allen Turner's children greet him every morning after his shift in Caswood, Ky. The August deaths of nine miners at Utah's Crandall Canyon mine were a grim reminder that coal mining is among the nation's most dangerous occupations.*

*From 1900 through 2006 more than 104,000 American mine workers died on the job.*

AP Photo/Debbie Caldwell

striking miners back to work.<sup>39</sup> A Venezuelan oil producer jokingly suggested building a statue of John L. Lewis, the combative president of the United Mine Workers of America, in Caracas' central square to honor his indirect role in boosting Venezuelan oil exports.<sup>40</sup>

Throughout the 1950s many users switched from coal to petroleum for heat and for powering ships and trains. Coal remained a crucial source of electricity, however, as demand for electric power swelled. Newly prosperous consumers spent their new postwar wealth on televisions, appliances and other goods, and industry and agriculture became increasingly automated. U.S. electricity generation more than quintupled between 1949 and 1970, with nearly half produced from coal-fired power plants.<sup>41</sup>

## Focus on Pollution

By 1970 many Americans worried that rapid economic growth was damaging the environment. Air pollution was a major concern. Since the late 1940s a number of "killer smog" events and temperature inversions (situations in which a mass of cold air settled on a region, preventing air pollutants from rising and dispersing) had killed thousands of people in urban areas, including London and New York City.<sup>42</sup> Deadly ingredients in these smogs included SO<sub>2</sub> and toxic metals, emitted from power plants and factories that burned coal and heavy fuel oil.<sup>43</sup>

Congress passed clean air laws in 1955 and 1963, but they mainly helped

states to address local air pollution, a strategy that was dwarfed by the national scope of the problem. A few months after the first Earth Day in April 1970, Congress adopted a major set of amendments to the Clean Air Act that directed the EPA to develop National Ambient Air Quality Standards for six so-called "criteria" pollutants, including SO<sub>2</sub>, NO<sub>x</sub>, ozone and particulate matter. To meet the standards, states were required to develop implementation plans that covered major pollution sources such as factories, refineries, power plants and motor vehicles.

Congress amended the Clean Air Act again in 1977, setting New Source Performance Standards to ensure that new air pollution sources installed advanced emission controls. Existing power plants were exempted, or "grandfathered," on the grounds that it would be extremely expensive to retrofit them to these standards, and many older plants were expected to cease operating within a few years in any case. If the plants made major modifications that increased their capacity, however, they were required to go through the same New Source Review (NSR) permitting process as newly built facilities.

The amended laws spurred research into pollution controls for power plants. Many new plants installed devices such as flue gas-desulfurization units ("scrubbers"), which removed SO<sub>2</sub> from the gas exiting coal boilers, and low-NO<sub>x</sub> burners designed to reduce nitrogen oxide formation during combustion. Some electric utilities turned to low-sulfur coal or cleaner fuels. Nuclear power's share of U.S. electric generation rose from less than 2 percent in 1970 to more than 10 percent in 1980 as reactors ordered in the 1960s and '70s came online, and electric generation from natural gas rose sharply in the early 1970s.

Coal received a boost when Arab countries embargoed oil exports to the United States in 1973, driving oil prices up sharply. Mining expanded, and most oil-burning power plants were converted to

coal or natural gas. The Carter administration initiated research on liquefying and gasifying coal to replace imported oil, but these projects proved to be extremely expensive and were tabled a few years later when oil prices declined.

Congress also moved to address the environmental impacts of coal mining by enacting the Surface Mining Control and Reclamation Act (SMCRA) in 1977. Strip mining had been widely practiced since the 1930s, scarring land and damaging rivers and streams with eroded dirt and mine waste. Minerals in coal produced acidic runoff when they came in contact with water, creating toxic drainage that polluted surrounding areas long after mines were shut down.

Critics sought to ban strip mining altogether, but SMCRA regulated the practice instead. The law barred strip mining in areas where it was deemed to be too damaging to the environment and required coal producers to pay per-ton fees into a fund to support reclamation projects on abandoned mine lands.

While mining impacts were debated mainly at the local level, controversy raged nationally through the 1980s over whether SO<sub>2</sub> and NO<sub>x</sub> emissions from coal-burning power plants were causing acid rain. In 1990 Congress amended the Clean Air Act yet again to create a cap-and-trade system for SO<sub>2</sub>. The law cut total allowable SO<sub>2</sub> emissions to 10 million tons below 1980 levels and assigned emission allowances to large sources, which they could either use to cover their emissions or sell to other generators who needed more allowances. The amendments also set less-stringent controls on NO<sub>x</sub> that limited plant emission rates but did not cap total emissions.

SO<sub>2</sub> emissions trading accelerated an ongoing shift away from traditional Eastern coal fields in northern Appalachia, which produced mainly bituminous coal, toward sub-bituminous coal that produced less heat but also contained less sulfur. The largest such deposits were in Wyoming, Montana and North Dako-

ta. To service the new demand for sub-bituminous, railroads deployed massive long-haul coal trains with more than 100 cars each, and Western energy companies developed large-scale surface mines that could be worked with gigantic bulldozers, excavators and draglines weighing thousands of tons.

President Bill Clinton's administration (1993-2001) brought further pressure to bear on the coal industry. Responding to a 1995 petition from Eastern states, EPA issued the Ozone Transport Rule requiring upwind sources to curb NO<sub>x</sub> emissions that were contributing to high ozone levels along the East Coast. In 1997 the agency set new standards limiting pollution from fine particulates with diameters of 2.5 micrometers or less (about 3 percent of the width of a human hair). Since sulfates and NO<sub>x</sub> contributed to fine-particle formation, the step was a new constraint on coal power plants.

President Clinton also endorsed the 1997 Kyoto Protocol, which required industrialized nations to make specific cuts in greenhouse gas emissions by 2012 in order to limit global climate change. Since coal power plants were one of the largest U.S. sources of CO<sub>2</sub>, energy and mining companies strongly opposed the pact. "It's really a double whammy when you combine this with the clean air regulations," said Taylor Pensoneau, vice president of the Illinois Coal Association.<sup>44</sup> Legislators were also concerned about the economic impacts of restricting CO<sub>2</sub> emissions: The U.S. Senate voted 95-0 against ratifying any climate change agreements unless developing countries also were required to limit emissions, and mandatory cuts could be shown not to threaten U.S. economic growth.

The administration further challenged coal-burning utilities when it filed suit against seven utilities in the Midwest and South and issued a separate administrative order against the Tennessee Valley Authority for violating the Clean Air Act by making major modifications to plants without going through the

new source review (NSR) process. The Justice Department charged owners of 32 coal plants with illegally emitting tens of millions of tons of SO<sub>2</sub>, NO<sub>x</sub> and particulates over many years.<sup>45</sup>

## Reversal of Fortune

In 1998 oil and natural gas prices, which had been quite steady for a decade or more, began to rise sharply due to factors that included rapid economic growth in China and India, tightening U.S. supplies and instability in many producing countries.<sup>46</sup> President George W. Bush's election in 2000, which was strongly supported by energy companies, dramatically altered prospects for the coal industry. The Bush administration saw coal as crucial to productivity and a healthy economy and moved quickly to alter policies that it viewed as harmful to coal use.

Less than two months after taking office, President Bush reversed a campaign pledge to limit CO<sub>2</sub> emissions, arguing that doing so would raise electricity prices and that CO<sub>2</sub> was not a pollutant under the Clean Air Act.<sup>47</sup> The Bush energy plan, released in May 2001, called for increased research on clean coal technologies and for a new market-based program to further reduce emissions of SO<sub>2</sub>, NO<sub>x</sub> and mercury. It also recommended reviewing NSR regulations and pending lawsuits to give plant owners more certainty about environmental controls.<sup>48</sup> Four days after the plan was released, the Ohio-based Cinergy Corp. backed out of an NSR settlement that would have reduced its emissions by 500,000 tons per year.<sup>49</sup>

The administration also eased restrictions on coal mining. Under the Clean Water Act, "dredged or fill materials" — which generally are used for a beneficial purpose, such as development — can be added to U.S. waterways under general permits rather than detailed individual permits. In 2002 EPA and the Army Corps of Engineers issued a rule

that allowed mine waste to be treated as "fill," making it easier for mountaintop-removal mining operations to dump waste into adjoining valleys and streams.<sup>50</sup> Another rule proposed in 2004 relaxed a regulation barring coal mining on land within 100 yards of streams that would be harmed by the activity.<sup>51</sup>

Environmental advocates strongly opposed the Bush administration's actions, arguing "Clear Skies" emissions-trading legislation proposed by the White House in 2003 did not reduce its targeted pollutants (SO<sub>2</sub>, NO<sub>x</sub>, and mercury) far enough or fast enough. After several years of stalemate on Capitol Hill, the EPA in 2005 proposed the Clean Air Interstate Rule (CAIR), which sets new limits on SO<sub>2</sub> and NO<sub>x</sub> emissions in 28 Eastern states, and the Clean Air Mercury Rule, which creates a national trading system to reduce mercury emissions from coal-fired power plants.

"CAIR will result in the largest pollution reductions and health benefits of any air rule in more than a decade," said Acting EPA Administrator Stephen Johnson, who stressed that the administration still aimed to pass national clean air legislation. Environmentalists called the measure a step forward but sharply opposed trading mercury emission allowances. Although President Bush's proposals built on the emissions-trading ideas that his father had helped to enact as president in the 1990 Clean Air Act amendments, the second Bush administration was unable to strike similar compromises. ■

## CURRENT SITUATION

### Environmental Challenges

Although dozens of new coal-burning power plants are planned or under construction, the latest coal

boom is meeting resistance from critics who want to shift the U.S. economy toward cleaner fuels. Even if electricity from coal is cheaper than other sources, they argue, the savings are far outweighed by its environmental and health impacts.

Greenhouse gas emissions are becoming coal's biggest environmental liability, as scientific and public support grows for action to slow global warming. In February 2007 the Intergovernmental Panel on Climate Change (IPCC), an organization created to advise national governments, released its fourth multi-year assessment of the scientific evidence for climate change. Weighing all natural and human influences on climate, the panel concluded in its strongest language to date that Earth was unquestionably warming and that most warming observed since the 1950s was "very likely" (more than a 90 percent chance) due to human activities.<sup>52</sup>

Polls indicate Americans are concerned about global climate change and ready to pay for solutions. In surveys conducted by researchers at MIT, public willingness to pay for solutions to climate change through higher electricity bills rose by 50 percent (from an average of \$10 to \$15 per month) between 2003 and 2006.<sup>53</sup> The findings indicate the public is increasingly open to policies such as carbon taxes that would raise the price of electricity.

With climate-change science growing clearer and state and public concern rising, many corporate leaders now believe the U.S. will adopt national limits on GHG emissions in the next decade. Some are asking Congress to act now so that they can make informed decisions about future investments. In January the U.S. Climate Action Partnership, a coalition including Alcoa, DuPont, General Electric and Caterpillar, called for binding limits to slow and reverse the growth of GHG emissions. Addressing climate change, the group said, "will create more economic opportunities than risks for the U.S. economy."<sup>54</sup>



## Coal Use Exploding in China and India

*Environmental impacts more severe than in U.S.*

Three nations account for 60 percent of world coal use: China (which burned 2.3 billion tons of coal in 2005), the United States (1.2 billion tons) and India (500 million tons).<sup>1</sup> Energy demand is growing rapidly in China and India, and both nations get most of their electricity from coal. The U.S. Department of Energy projects that world coal consumption will rise by 74 percent from 2004 through 2030, and that China and India will account for nearly three-fourths of the increase.<sup>2</sup>

Environmental and health impacts from coal use in developing countries are much more severe than those seen in the United States. Air pollution levels in China far exceed both the country's own national standards and recommended air-quality guidelines from the World Health Organization, partly because the nation burns huge quantities of coal in inefficient power plants and factories.

China is the world's biggest source of SO<sub>2</sub>, which produces industrial smog and acid rain. Many rural Chinese families also use coal for indoor heating and cooking, creating indoor air pollution that causes thousands of premature deaths every year. "The coal that has powered China's economic growth . . . is also choking its people," writes Elizabeth Economy, director for Asia studies at the influential Council on Foreign Relations, a non-partisan think tank.<sup>3</sup>

On average, China opens a new coal-burning power plant every week. China displaced the United States in 2007 as the top global CO<sub>2</sub> emitter, making Beijing's heavy reliance on coal a global concern.<sup>4</sup> Some advocates argue the United States should help China adopt advanced clean-coal technologies, but others say outsiders have little leverage over fragmented and poorly coordinated Chinese energy policies. China has begun to research and design advanced, clean coal power plants that can capture carbon emissions, but its near-term focus is on building a string of coal-to-liquid fuel plants to displace some of its oil imports with synthetic fuels.



*Cooling towers dwarf the surroundings at a power plant near Zhangjiakou, in China's Hebei province.*

AFP/Getty Images/Frederic J. Brown

Significant economic aid could help persuade China and other developing countries to clean up their energy policies. Many experts also say that the U.S. needs to lead. "Without a strong U.S. commitment [on greenhouse gas reductions], the international community has no credibility in pressuring the Chinese," Economy observes.<sup>5</sup>

India's population is almost as large as China's, and its economy is also growing quickly, although per-capita energy use in India is currently only about one-third of that in China. India is exploring many energy options and would like to use more of its domestic coal supplies, but much Indian coal has a high ash content, which makes it more polluting and reduces its heat content. As a result, Indian plants must burn more coal to produce a given amount of heat. According to the Brookings Institution, a centrist think tank,

India will exhaust its proven coal reserves within 80 years if it keeps burning coal at current rates.<sup>5</sup>

In 2005 the United States and India began discussing ways to mine coal more efficiently and use it more cleanly. And both India and China are participating in FutureGen, a 10-year effort announced by President George W. Bush in 2003 to build a clean coal-burning plant that can produce electricity and hydrogen fuel while capturing and storing carbon emissions.

Meanwhile, because its fastest growth in energy use is projected to take place in the decade after 2020, India may have greater

opportunities to introduce clean-coal technologies than China, where dozens of conventional coal plants are already being built.

<sup>1</sup> U.S. Energy Information Administration, "International Coal Consumption," [www.eia.doe.gov/emeu/international/coalconsumption.html](http://www.eia.doe.gov/emeu/international/coalconsumption.html).

<sup>2</sup> U.S. Energy Information Administration, "International Energy Outlook 2007," May 2007, pp. 49, 53.

<sup>3</sup> Elizabeth C. Economy, "The Great Leap Backward?" *Foreign Affairs*, September/October 2007.

<sup>4</sup> John Vidal and David Adam, "China Overtakes U.S. as World's Biggest CO<sub>2</sub> Emitter," *The [Manchester] Guardian*, June 19, 2007.

<sup>5</sup> Elizabeth Economy, "China vs. Earth," *The Nation*, May 7, 2007.

<sup>6</sup> Tanvi Madan, India, Brookings Foreign Policy Studies Series, November 2006, pp. 81-83.

The prospect of GHG limits complicates planning for energy companies, which make decisions about new power plants on multidecade timetables.

"The industry probably took longer than it should have to accept the science," says Mayo Shattuck, president and CEO of Constellation Energy, a *Fortune* 200 company that generates elec-

tricity from nuclear power, coal, oil, gas and renewable fuels. "But now companies are trying to formulate policies so that we can deal with climate change

*Continued on p. 834*



# At Issue:

## *Should the U.S. government subsidize liquid fuels from coal?*



**JOHN N. WARD**  
**VICE PRESIDENT, HEADWATERS INC.**

**TESTIMONY BEFORE HOUSE SUBCOMMITTEE ON ENERGY AND ENVIRONMENT, SEPT. 5, 2007**

**W**ith coal-to-liquids technology, the United States can take control of its energy destiny. Any product made from oil can be made from coal. At today's oil prices, coal-to-liquids is economical and has the power to enhance energy security, create jobs here at home, lessen the U.S. trade deficit and provide environmentally superior fuels that work in today's vehicles. By building even a few coal-to-liquids plants, the U.S. would increase and diversify its domestic production and refining base — adding spare capacity to provide a shock absorber for price volatility. . . .

From a production perspective, coal-to-liquids refineries are very similar to petroleum refineries. They make the same range of products, including gasoline, diesel fuel, jet fuel and chemical feedstocks. These fuels can be distributed in today's pipelines without modification. They can be blended with petroleum-derived fuels if desired. They can be used directly in today's cars, trucks, trains and airplanes without modifications to the engines. . . .

The production of coal-to-liquids fuels is also environmentally responsible. Because coal-liquefaction processes remove contaminants from coal prior to combustion, emissions from coal-to-liquids plants are much lower than traditional pulverized-coal power plants. . . .

[C]oal liquefaction plants generate carbon dioxide in highly concentrated form, allowing carbon capture and storage. Coal-to-liquids plants with carbon-dioxide capture and storage can produce fuels with life-cycle greenhouse-gas-emission profiles that are as good as or better than that of petroleum-derived products. . . .

Although larger-scale coal-to-liquids projects appear to be economically viable in today's oil-price environment, there are still significant hurdles to get the first projects built. There are no coal-to-liquids plants operating in the U.S. that would serve as commercially proven models. Until that happens, financial institutions will be reluctant to fund multibillion-dollar projects without significant technology and market-performance guarantees. . . .

As long as oil prices remain high or climb higher, market forces will lead to the development of a coal-to-liquids infrastructure in the United States. But that development will come slowly and in measured steps. If, for energy-security reasons, the United States would like to speed development of a capability for making transportation fuels from our most abundant domestic energy resource, then incentives for the first coal-to-liquids project are appropriate.



**DAVID HAWKINS**  
**DIRECTOR, CLIMATE CENTER, NATURAL RESOURCES DEFENSE COUNCIL**

**TESTIMONY BEFORE HOUSE SUBCOMMITTEE ON ENERGY AND ENVIRONMENT, SEPT. 5, 2007**

**C**oal is a carbon-intensive fuel, containing double the amount of carbon per unit of energy compared to natural gas and about 50 percent more than petroleum. When coal is converted to liquid fuels, two streams of CO<sub>2</sub> are produced: one at the liquid-coal production plant and the second from the exhausts of the vehicles that burn the fuel. . . . [E]ven if the CO<sub>2</sub> from the synfuel production plant is captured, there is no prospect that liquid fuel made with coal as the sole feedstock can achieve the significant reductions in fossil carbon content that we need to protect the climate. . . .

EPA's analysis finds that without carbon capture life-cycle greenhouse-gas emissions from coal-to-liquid fuels would be more than twice as high as from conventional diesel fuel (118 percent higher). Assuming carbon capture and storage, EPA finds that life-cycle greenhouse-gas emissions from coal-to-liquid fuels would be 3.7 percent higher than from conventional diesel fuel. . . .

In the West, as in the East, surface-mining activities cause severe environmental damage as huge machines strip, rip apart and scrape aside vegetation, soils [and] wildlife habitat and drastically reshape existing land forms and the affected area's ecology to reach the subsurface coal. Strip mining results in industrialization of once quiet open space along with displacement of wildlife, increased soil erosion, loss of recreational opportunities, degradation of wilderness values and destruction of scenic beauty. . . .

According to the Department of Energy's Idaho National Lab, approximately 12-14 barrels of water are used for every barrel of liquid coal. Therefore the water requirement necessary to meet the needs of an 80,000 BPD [barrels per day] liquid-coal plant could require sourcing about 40 million gallons of water per day (14 billion gallons per year). The 40 million gallons of water per day needed for an 80,000 BPD liquid coal facility is enough water to meet the domestic needs of more than 200,000 people. . . . There are already serious water-supply problems in Western states such as Montana and Wyoming, where most of our cheap coal supplies are located. . . .

The impacts that a large liquid-coal program could have on global warming pollution, conventional air pollution and damage from expanded coal production are substantial — so substantial that using coal to make liquid fuel would likely create far worse problems than it attempts to solve.

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in a manageable way. We need to find incentives for new technologies and migrate away from traditional coal.”

Many factors influence utility decisions to use particular fuels, including cost, availability and government policies. Providing a steady supply of energy is a prime concern, especially with demand rising. “Our capital is limited, and reliability is a huge issue,” says Shattuck. “People expect that the lights will always go on, so we don’t want to make many investment mistakes.”

Even if utilities try to innovate, regulators may favor a tried-and-true path. For example, Wisconsin-based We Energies proposed to build a coal gasification plant in 2003, but the state public service commission held that the technology was too expensive and technically risky and rejected the unit. Now Wisconsin companies are building conventional coal plants.<sup>55</sup>

The Bush administration has resisted proposals for mandatory GHG reductions, arguing that would drive up energy prices and harm the U.S. economy. Recently, Bush has supported international proposals for negotiating an international agreement that, unlike the Kyoto Protocol, will require action from developing as well as industrialized countries to address global warming. However, the Bush administration’s biggest step toward this goal has been to call for a meeting of heads of state in 2008 to agree on a long-term reduction goal.<sup>56</sup>

## National Legislation

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Since Democrats won majorities in both houses of Congress in 2006, momentum has grown for national legislation to promote clean energy sources and limit GHG emissions. But both issues affect virtually every sector of the U.S. economy, so agreement will not be quick or easy.<sup>57</sup>

Both houses of Congress have passed energy bills that would speed

up work on carbon capture and storage (CCS) by requiring the Energy Department to carry out at least seven large-scale carbon-sequestration demonstrations (storing at least 1 million tons of CO<sub>2</sub> per year) in a variety of geologic formations, as recommended in the MIT coal study. Each bill would increase federal CCS funding by about \$1.5 billion over the next five years.<sup>58</sup>

The energy measures, however, are part of broader bills that contain many controversial provisions, such as a national renewable-energy mandate and higher vehicle fuel-economy standards. House and Senate leaders plan to resolve the bills in conference this fall, but the schedule is undetermined. If the CCS provisions are not enacted into law, current Energy Department work to demonstrate CCS could remain at a level the MIT study called “completely inadequate,” warning that slow progress on CCS technology and regulations could keep the United States from enacting carbon controls in a timely way.<sup>59</sup>

“A lot of moving parts have to fit together to make carbon capture and storage work,” says MIT study coauthor Howard Herzog. “We should be getting the technology figured out, so it can be ready to go when the market conditions are right.”

During its debate on the House carbon capture and storage bill, the Senate rejected two amendments that would have revived federal support for producing coal-to-liquids (CTL) fuels, a step that advocates said would reduce U.S. dependence on imported oil. (See “*At Issue*,” p. 833.) Coal-state legislators may try to revive federal support for CTL during conference on the energy bill, but with climate change looming in the background, many legislators are wary of measures that would increase U.S. reliance on coal.

Democratic leaders in Congress plan to move legislation in both houses during this session to reduce U.S. GHG emissions by roughly 70 percent by 2050, a level that many scientists say

is needed to avoid catastrophic levels of global climate change. Such action would raise the cost of generating electricity from coal and spur a move away from traditional coal plants and toward more efficient designs with CCS as well as lower-carbon fuels.

Some energy companies are rushing to build new coal plants before climate legislation passes, but prominent Democrats have warned that they will not “grandfather” operating plants from complying with GHG reductions. “Any company planning to spend billions of dollars on new coal-fired power plants, and any investor in such a company, should think carefully about how to spend their funds so as to be part of the solution to climate change, not a part of the problem,” Senate committee chairs Jeff Bingaman, D-N.M. (Energy and Natural Resources) and Barbara Boxer, D-Calif. (Environment and Public Works) wrote in a January op-ed.<sup>60</sup>

Congress is addressing other coal issues this fall as well. Responding to the August Crandall Canyon mining disaster, several Senate committees are holding hearings on mine safety and the adequacy of federal oversight. Legislators in both houses have already introduced bills to speed up technical improvements in mine communications and increase fines for accidents.<sup>61</sup> And 92 House members have cosponsored the Clean Water Protection Act, introduced by Rep. Frank Pallone Jr., D-N.J., which would end dumping of mountaintop mining waste into streams.

## Muffled Boom?

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Concerns about pollution could deflate the nascent U.S. coal boom. Some two-dozen coal plants have been cancelled since early 2006, including the TXU cancellations in Texas and projects in Florida, Montana, North Carolina and Oregon.<sup>62</sup> Senate Majority Leader Harry Reid of Nevada is publicly opposing three proposed plants in his

home state. "I will use every means at my disposal to prevent the construction of new coal-fired plants in Nevada that do not capture and permanently store greenhouse gas emissions," Reid wrote in July.<sup>63</sup>

Many facilities are still moving forward, including planned or proposed coal gasification plants in a dozen states. But investors are cooling on the coal industry. In July Citigroup's equity research division downgraded coal stocks across the board, based on low expected earnings and a hostile political outlook. "[P]rophesies of a new wave of coal-fired generation have vaporized, while clean-coal technologies such as IGCC [integrated gasification combined cycle] with carbon capture and coal-to-liquids remain a decade away, or more," wrote Citigroup analyst John Hill.<sup>64</sup> Prices of a dozen large coal companies were down 11 to 38 percent from their 52-week highs in early September.<sup>65</sup>

"A lot of countervailing trends have emerged in the past year," says Ceres electric power program director Bakal. "There's new awareness of climate change and discussion of regulating carbon emissions. Also, the cost of building any kind of new generating plant is rising because the costs of commodities and labor are rising. And there's increasing recognition that energy-efficiency measures are a cheaper and quicker way to address rising electricity demand than building new plants, so states are providing new incentives for energy-efficiency programs." ■

## OUTLOOK

### Energy Choices

Coal's role in the nation's energy portfolio in the coming decades

will be shaped by market signals from government officials. If Congress moves quickly to set greenhouse gas reduction targets and boosts support for clean-coal technologies like gasification and carbon capture, energy company investments will follow. Without policy and economic incentives, corporations will have less reason to take the low-carbon path.

"We need a strong partnership with the federal government to develop new technologies for managing coal emissions, including carbon," says National Mining Association Vice President Raulston. "That's going to be very expensive, and the industry needs help to bring these systems to the deployment stage."

Conventional pollutants like SO<sub>2</sub> and NO<sub>x</sub> are still serious concerns. The American Lung Association's most recent report card on U.S. air quality found that fine-particulate air pollution rose in the Eastern United States from 2003-2005, after consistent decreases from 1999 through 2003, mainly because of increased generation by coal-burning power plants. Building more coal-burning plants will increase pollution levels in some areas, the study warned, even if all new plants use the best available pollution-control technology — which is not guaranteed under current law.<sup>66</sup>

"We need tighter limits on coal-fired plants," says the lung association's Nolen. "Delaying and weakening regulations will mean more unnecessary deaths and more harm to public health."

Meanwhile, major investments in energy efficiency could buy time to expand less-polluting energy sources. Saving a kilowatt-hour of electricity through energy-efficiency measures is often quicker and cheaper than generating it at a power plant and can help avert the need to build new plants. Statewide conservation initiatives launched in California after its energy supply crisis in 2000-2001 have reduced per-capita electricity use to record lows. In 2005 the average Californian used 7,032 kilowatt-hours, two to four times lower than consumers in many other states.<sup>67</sup>

"Demand management and efficiency should be priorities, because we can do something about that now," says Constellation Energy's Shattuck. "There's no more cheap power — people have to use less energy, and they have to understand the technologies and their own usage patterns so they can reduce their energy use. We can't build ourselves out of this situation."

Critics want to phase conventional coal plants (without carbon capture and sequestration) out of U.S. energy policy, given the environmental and health impacts of mining and transporting as well as burning it. "The trend is going to be toward energy efficiency and renewables, and toward carbon capture. We can't afford to keep automatically building coal plants, from a human-health standpoint or an economic standpoint," says Coken of Western Resource Advocates.

Ironically, however, the MIT coal study concluded that if carbon capture and storage is adopted successfully, the world will use more coal, not less, in coming decades.<sup>68</sup> Given how heavily other nations rely on coal, especially India and China, the United States has a long-term interest in making coal energy cleaner and safer, even if our own fuel mix shifts toward lower-carbon sources. Rep. Edward Markey, D-Mass., chairman of the House Select Energy Committee on Energy and Global Warming, warns, "If we do not solve this challenge, our fight to protect the planet from global warming will be lost before it even gets started."<sup>69</sup> ■

## Notes

<sup>1</sup> According to the Department of Energy, average residential energy use in 2005 was 938 kilowatt hours per month, or 11,256 kilowatt hours (11.25 megawatt hours) per year. U.S. Department of Energy, Energy Information Administration, "Frequently Asked Questions — Energy," [http://tonto.eia.doe.gov/ask/electricity\\_faqs.asp#electricity\\_use\\_home](http://tonto.eia.doe.gov/ask/electricity_faqs.asp#electricity_use_home).

<sup>2</sup> Environmental Integrity Project, "Dirty Kilowatts: America's Most Polluting Power Plants"

(July 2007). Bowen's mercury emissions ranked 14th among power plants nationwide in 2005, the most recent year for which data was available.

<sup>3</sup> U.S. Department of Energy, National Energy Technology Laboratory, "Tracking New Coal-Fired Power Plants," May 1, 2007, [www.netl.doe.gov/coal/refshelf/ncp.pdf](http://www.netl.doe.gov/coal/refshelf/ncp.pdf).

<sup>4</sup> U.S. Energy Information Administration, "Annual Energy Outlook 2007," pp. 82-84.

<sup>5</sup> U.S. Department of Labor, Mine Safety and Health Administration, "Coal Fatalities for 1900 through 2006," [www.msha.gov/stats/centurystats/coalstats.asp](http://www.msha.gov/stats/centurystats/coalstats.asp). For background see Pamela M. Prah, "Coal Mining Safety," *CQ Researcher*, March 17, 2006, pp. 241-264.

<sup>6</sup> For example, see Douglas W. Dockery, *et al.*, "An Association Between Air Pollution and Mortality in Six U.S. Cities," *The New England Journal of Medicine*, vol. 329, no. 24 (1993), pp. 1753-1759; C. Arden Pope, *et al.*, "Lung Cancer, Cardiopulmonary Mortality, and Long-Term Exposure to Fine Particulate Air Pollution," *JAMA (Journal of the American Medical Association)*, vol. 287, no. 9 (2002), pp. 1132-1141; and Abt Associates, Inc., "Power Plant Emissions: Particulate Matter-Related Health Damages and the Benefits of Alternative Emission Reduction Scenarios," June 2004, [www.catf.us/publications/reports/Power\\_Plant\\_Emissions.pdf](http://www.catf.us/publications/reports/Power_Plant_Emissions.pdf).

<sup>7</sup> For background see Adriel Bettelheim, "Bio-fuels Boom," *CQ Researcher*, Sept. 29, 2006, pp. 793-816; Barbara Mantel, "Energy Efficiency," *CQ Researcher*, May 19, 2006, pp. 433-456; and Mary H. Cooper, "Alternative Fuels," *CQ Researcher*, Feb. 25, 2005, pp. 173-196.

<sup>8</sup> For background see Jennifer Weeks, "Nuclear Energy," *CQ Researcher*, March 10, 2006, pp. 217-240.

<sup>9</sup> National Research Council, "Coal: Research and Development To Support National Energy Policy," prepublication copy, 2007, p. 3.

<sup>10</sup> Matthew L. Wald, "Committed To Coal, and In A Hurry, Too," *The New York Times*, Nov. 7, 2006.

<sup>11</sup> Sierra Club, "TXU Announces New Coal Fired Power Plants," April 21, 2006.

<sup>12</sup> Andrew Ross Sorkin, "A \$45 Billion Buyout Deal With Many Shades of Green," *The New York Times*, Feb. 26, 2007; *Independent Assessment of Proposed Leveraged Buyout of TXU: The Impact on Consumers* (Washington, DC: GF Energy LLC), June 2007, pp. 59-61.

<sup>13</sup> For background see Tom Price, "Corporate Social Responsibility," *CQ Researcher*, Aug. 3, 2007, pp. 649-672.

<sup>14</sup> For background see Marcia Clemmitt, "Climate Change," *CQ Researcher*, Jan. 27, 2006, pp. 73-96.

<sup>15</sup> Carbon dioxide (CO<sub>2</sub>) is a molecule containing one carbon atom and two oxygen atoms. By weight, CO<sub>2</sub> is about 27 percent carbon. Since carbon is the substance that traps heat in the atmosphere and causes global climate change, regulators often talk interchangeably about controlling either CO<sub>2</sub> emissions or carbon emissions. In either case the objective is to prevent the carbon component from being released.

<sup>16</sup> Stephen Ansolabehere, *et al.*, *The Future of Coal: Options For a Carbon-Constrained World* (2007).

<sup>17</sup> Amanda Griscom Little, "Let's Call the Coal Thing Off," *Grist*, March 9, 2007; James Hansen, "Why We Can't Wait," *The Nation*, May 7, 2007.

<sup>18</sup> Chris Dodd For President, "The Dodd Energy Plan," [http://chrisdodd.com/energy\\_independence/plan](http://chrisdodd.com/energy_independence/plan); John Edwards For President, "Edwards Calls For Cleaner Use of Coal as Part of Fight Against Global Warming," <http://johnedwards.com/news/headlines/2007/0326-cleaner-coal/>.

<sup>19</sup> Margot Roosevelt, "State Acts To Limit Use of Coal Power," *Los Angeles Times*, May 24, 2007.

<sup>20</sup> S. 1227, the Clean Coal Act of 2007, introduced April 26, 2007.

<sup>21</sup> "Climate Policy, Energy Efficiency Take Center Stage at State Regulators' Summer Conference," *Electric Utility Week*, July 23, 2007.

<sup>22</sup> David Hawkins and George Peridas, "No Time Like the Present: NRDC's Response to MIT's 'Future of Coal' Report," March 2007, pp. 6-9, [www.nrdc.org/globalWarming/coal/mit.pdf](http://www.nrdc.org/globalWarming/coal/mit.pdf).

<sup>23</sup> Based on EPA's reference dose for mercury of 0.1 micrograms per kilogram of body weight per day.

<sup>24</sup> U.S. Environmental Protection Agency, Office of Water, "2005/2006 National Listing of Fish Advisories," July 2007, [www.epa.gov/waterscience/fish/advisories/2006/tech.pdf](http://www.epa.gov/waterscience/fish/advisories/2006/tech.pdf).

<sup>25</sup> Rick Srivastava, Nick Hutson, and Frank Princiotta, U.S. Environmental Protection Agency, Office of Research and Development, "Reduction of Mercury Emissions From Coal-Fired Electric Utility Boilers," July 12, 2005, [www.netl.doe.gov/publications/proceedings/05/Mercury/pdf/Srivastava-071205-am.pdf](http://www.netl.doe.gov/publications/proceedings/05/Mercury/pdf/Srivastava-071205-am.pdf).

<sup>26</sup> Senate Joint Res. 20, defeated 47-51 with two members not voting, Sept. 13, 2005.

<sup>27</sup> David C. Evers, *et al.*, "Biological Mercury Hotspots in the Northeastern United States and Southeastern Canada," *BioScience*, Vol. 57, No. 1, January 2007, pp. 29-43.

<sup>28</sup> Charles T. Driscoll, *et al.*, "Mercury Contamination in Forest and Freshwater Ecosystems in the Northeastern United States," *BioScience*, Vol. 57, No. 1, January 2007, pp. 17-28.

<sup>29</sup> "Mercury Matters: Linking Mercury Science With Public Policy in the Northeastern United States," Hubbard Brook Research Foundation, January 2007, p. 6.

<sup>30</sup> U.S. Environmental Protection Agency, Region 3, "Mountaintop Mining/Valley Fills In Appalachia: Final Programmatic Environmental Impact Statement," October 2005, p. 4. "Mountaintop mining" as defined in the report includes mountaintop removal and other surface-mining methods on mountain slopes.

<sup>31</sup> EPA, "Mountaintop Mining/Valley Fills in Appalachia: Draft Programmatic Environmental Impact Statement," p. III. A-6.

<sup>32</sup> Ken Ward Jr., "Mines Might Get More Time on Selenium," *Charleston Gazette*, March 4, 2007.

<sup>33</sup> Testimony before House Committee on Natural Resources, July 25, 2007, p. 2.

<sup>34</sup> Testimony before House Committee on Natural Resources, July 25, 2007, p. 6.

<sup>35</sup> *Ohio Valley Environmental Coalition, et al., v. United States Army Corps of Engineers, et al.*, Civil Action No. 3:05-0784, March 23, 2007.

<sup>36</sup> Ken Ward Jr., "Mine Ponds Ruled Illegal," *Charleston Gazette*, June 14, 2007; Beth Gorczyca Ryan, "Federal Pond Ruling Troubles

## About the Author



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Coal," *The State Journal*, June 21, 2007.

<sup>37</sup> Ryan, *op. cit.*

<sup>38</sup> For background see University of Denver Department of Anthropology, Colorado Coal Field War Project, "A History of the Colorado Coal Field War," [www.du.edu/anthro/ludlow/cfhist.html](http://www.du.edu/anthro/ludlow/cfhist.html).

<sup>39</sup> See University of California, Santa Barbara, The American Presidency Project, Fireside Chat #46, May 2, 1943, [www.presidency.ucsb.edu/ws/index.php?pid=16393](http://www.presidency.ucsb.edu/ws/index.php?pid=16393).

<sup>40</sup> Daniel Yergin, *The Prize: The Epic Quest For Oil, Money and Power* (1991), p. 543.

<sup>41</sup> U.S. Energy Information Administration, "Annual Energy Review 2006" (2007), p. 226.

<sup>42</sup> U.S. Environmental Protection Agency, Region 10, "Air Pollution Events in History," Sept. 15, 2003, <http://yosemite.epa.gov/r10/homepage.nsf>.

<sup>43</sup> Coal emissions were mainly a problem in the Eastern United States, while Los Angeles' notorious air-pollution problems stemmed from other sources such as vehicle exhaust and hydrocarbons from oil refineries. South Coast Air Quality Management District, "The Southland's War on Smog: Fifty Years of Progress Toward Clean Air," May 1997, [www.aqmd.gov/news1/Archives/History/marchcov.html](http://www.aqmd.gov/news1/Archives/History/marchcov.html).

<sup>44</sup> William Flannery, "Global Warming Treaty: What It Would Mean for St. Louis," *St. Louis Post-Dispatch*, Dec. 12, 1997.

<sup>45</sup> "U.S. Sues Electric Utilities in Unprecedented Action to Enforce the Clean Air Act," EPA press release, Nov. 3, 1999.

<sup>46</sup> For background see Jennifer Weeks, "Domestic Energy Development," *CQ Researcher*, Sept. 30, 2005, pp. 809-832.

<sup>47</sup> Robert Schlesinger, "Bush Bars New Control on Emission," *The Boston Globe*, March 14, 2001.

<sup>48</sup> National Energy Policy Development Group, "Reliable, Affordable, and Environmentally Sound Energy for America's Future" (May 2001), pp. 3-3, 5-13 to 5-15, [www.whitehouse.gov/energy/2001/National-Energy-Policy.pdf](http://www.whitehouse.gov/energy/2001/National-Energy-Policy.pdf).

<sup>49</sup> Clear the Air, "Timeline: Power Plant Cleanup and New Source Review," [www.cleartheair.org/proactive/newsroom/release.vtml?id=21840#12](http://www.cleartheair.org/proactive/newsroom/release.vtml?id=21840#12).

<sup>50</sup> Jeff Nesmith, "Bush Pushes Mountaintop Removal Mining," *Atlanta Journal-Constitution*, April 14, 2002.

<sup>51</sup> "Interior Department Set to Relax Rules Regarding Mining Near Streams," *U.S. Coal Review*, Jan. 12, 2004.

<sup>52</sup> Intergovernmental Panel on Climate Change, *Climate Change 2007: The Scientific Basis, Summary for Policymakers* (2007), p. 8.

<sup>53</sup> Ansolabehere, *et al.*, *op. cit.*, p. 90.

## FOR MORE INFORMATION

**American Lung Association**, 61 Broadway, 6th Floor, New York, NY 10006; (212) 315-8700; [www.lungusa.org](http://www.lungusa.org). Funds research and carries out advocacy and public education on issues associated with fighting lung diseases, including environmental health.

**Clean Air Markets Program**, U.S. Environmental Protection Agency, 1200 Pennsylvania Ave., N.W., Mail Code 6204J, Washington, DC 20460; (202) 343-9150; [www.epa.gov/airmarkets](http://www.epa.gov/airmarkets). Administers market-based programs to reduce emissions.

**Coal River Mountain Watch**, P.O. Box 651, Whitesville, WV 25209; (304) 854-2182; [www.crmw.net](http://www.crmw.net). Works to halt mountaintop mining in West Virginia.

**Coal-to-Liquids Coalition**, (202) 463-9789; [www.futurecoalfuels.org](http://www.futurecoalfuels.org). A coalition of labor, mining, and industry groups promoting liquefied-coal fuels.

**Edison Electric Institute**, 701 Pennsylvania Avenue, N.W., Washington, DC 20004; (202) 508-5000; [www.eei.org](http://www.eei.org). Represents shareholder-owned electric companies.

**Energy Information Administration**, U.S. Department of Energy, 1000 Independence Ave., S.W., Washington, DC 20585; (202) 586-8800; [www.eia.doe.gov](http://www.eia.doe.gov). Central source for U.S. government data and forecasts on energy.

**Hubbard Brook Research Foundation**, 16 Buck Road, Hanover, NH 03755; (603) 653-0390; [www.hubbardbrookfoundation.org](http://www.hubbardbrookfoundation.org). Supports long-term research at the Hubbard Brook experimental forest in central New Hampshire.

**National Mining Association**, 1010 Constitution Ave., N.W., Suite 500 East, Washington, DC 20001; (202) 463-2600; [www.nma.org](http://www.nma.org). Represents the mining industry.

**Office of Surface Mining Reclamation and Enforcement**, U.S. Department of the Interior, 1951 Constitution Ave., N.W., Washington, DC 20240; (202) 208-2719; [www.osmre.gov](http://www.osmre.gov). Regulates mountaintop removal.

**Western Resource Advocates**, 2260 Baseline Road, Suite 200, Boulder, CO, 80302; (303) 444-1188; [www.westernresourceadvocates.org](http://www.westernresourceadvocates.org). Nonprofit law and policy group that advocates for environmental protection in interior Western states.

<sup>54</sup> United States Climate Action Partnership, *A Call for Action* (2007), p. 3.

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## *Additional Articles from Current Periodicals*

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